

$$10 \log_{10} \frac{1}{A} \sum_{i=1}^N \text{e.i.r.p.}(a_i) \text{ dBW/MHz-km}^2$$

where:

N = number of co-frequency hubs in BTA.

A = Area of BTA in km².

e.i.r.p. (ai) = equivalent isotropic radiated spectral power density of the i-th hub (in W/MHz) at elevation angle a where a is the angle in degrees of elevation above horizon. e.i.r.p.(0°) is the hub e.i.r.p. area density at the horizon used in Section 101.113c(2). The nominal antenna pattern will be used for elevation angles between 0° and 8°, and average levels will be used for angles beyond 8°, where average levels will be calculated by sampling the antenna patterns in each 1° interval between 8° and 9015, dividing by 83.

TABLE 2

Elevation angle (a)	Relative e.i.r.p. density (dBW/MHz-km ²)
0° ≤ a ≤ 4.0°	e.i.r.p.(a) = e.i.r.p.(0°) + 20 log (sinΠ x)/(1/Π x) where x = (a + 1)/7.5°.
4.0° < a ≤ 7.7°	e.i.r.p.(a) = e.i.r.p.(0°) - 3.85a + 7.7.
a > 7.7°	e.i.r.p.(a) = e.i.r.p.(0°) - 22.

(ii) LMDS system licensees in two or more BTAs may individually or collectively deviate from the spectral area density computed above by averaging the power over any 200 km by 400 km area, provided that the aggregate interference to the satellite receiver is no greater than if the spectral area density were as specified in Table 1. A showing to the Commission comparing both methods of computation is required and copies shall be served on any affected non-GSO MSS providers.

(4) *Power reduction techniques.* LMDS hub transmitters shall employ methods to reduce average power levels received by non-geostationary mobile satellite receivers, to the extent necessary to comply with paragraphs (c)(1) and (c)(2) of this section, by employing the methods set forth below:

(i) *Alternate polarizations.* LMDS hub transmitters in the LMDS service area may employ both vertical and horizontal linear polarizations such that 50 percent (plus or minus 10 percent) of the hub transmitters shall employ vertical polarization and 50 percent (plus or minus 10 percent) shall employ horizontal polarization.

(ii) *Frequency interleaving.* LMDS hub transmitters in the LMDS service area may employ frequency interleaving such that 50 percent (plus or minus 10 percent) of the hub transmitters shall employ channel center frequencies which are different by one-half the channel bandwidth of the other 50 percent (plus or minus 10 percent) of the hub transmitters.

(iii) *Alternative methods.* As alternatives to paragraphs (c)(4)(i) and (c)(4)(ii) of this section, LMDS operators may employ such other methods as may be shown to achieve equivalent reductions in average power density received by non-GSO MSS satellite receivers.

[61 FR 26677, May 28, 1996]

EDITORIAL NOTE: For FEDERAL REGISTER citations affecting § 101.113, see the List of CFR Sections Affected, which appears in the Finding Aids section of the printed volume and on GPO Access.

§ 101.115 Directional antennas.

(a) Unless otherwise authorized upon specific request by the applicant, each station authorized under the rules of this part must employ a directional antenna adjusted with the center of the major lobe of radiation in the horizontal plane directed toward the receiving station with which it communicates: *provided, however*, where a station communicates with more than one point, a multi- or omni-directional antenna may be authorized if necessary. New Periscope antenna systems will not, under ordinary circumstances, be authorized.

(b) Fixed stations (other than temporary fixed stations and DEMS nodal stations) operating at 932.5 MHz or higher must employ transmitting and receiving antennas (excluding second receiving antennas for operations such as space diversity) meeting the appropriate performance Standard A indicated below, except that in areas not subject to frequency congestion, antennas meeting performance Standard B may be used, subject to the requirements set forth in paragraph (d) of this section. Licensees shall comply with the antenna standards table shown in this paragraph in the following manner:

Federal Communications Commission

§ 101.115

(1) With either the maximum beamwidth to 3 dB points requirement or with the minimum antenna gain requirement; and

(2) With the minimum radiation suppression to angle requirement.

ANTENNA STANDARDS

Frequency (MHz)	Category	Maximum beamwidth to 3 dB points ¹ (included angle in degrees)	Minimum antenna gain (dbi)	Minimum radiation suppression to angle in degrees from centerline of main beam in decibels						
				5° to 10°	10° to 15°	15° to 20°	20° to 30°	30° to 100°	100° to 140°	140° to 180°
932.5 to 935	A	14.0	n/a	n/a	6	11	14	17	20	24
	B	20.0	n/a	n/a	n/a	6	10	13	15	20
941.5 to 944	A	14.0	n/a	n/a	6	11	14	17	20	24
	B	20.0	n/a	n/a	n/a	6	10	13	15	20
952 to 960 ^{2,3}	A	14.0	n/a	n/a	6	11	14	17	20	24
	B	20.0	n/a	n/a	n/a	6	10	13	15	20
1,850 to 2,500 ⁴	A	5.0	n/a	12	18	22	25	29	33	39
	B	8.0	n/a	5	18	20	20	25	28	36
3,700 to 4,200	A	2.7	36	23	29	33	36	42	55	55
	B	2.7	36	20	24	28	32	32	32	32
5,925 to 6,425 ⁵	A	2.2	38	25	29	33	36	42	55	55
	B	2.2	38	21	25	29	32	35	39	45
5,925 to 6,425 ⁶	A	2.2	38	25	29	33	36	42	55	55
	B	2.2	38	20	24	28	32	35	36	36
6,525 to 6,875 ⁵	A	2.2	38	25	29	33	36	42	55	55
	B	2.2	38	21	25	29	32	35	39	45
6,525 to 6,875 ⁶	A	1.5	n/a	26	29	32	34	38	41	49
	B	2.0	n/a	21	25	29	32	35	39	45
10,550 to 10,680 ⁷	A	3.5	33.5	18	24	28	32	35	55	55
	B	3.5	33.5	17	24	28	32	35	40	45
10,565 to 10,615	n/a	360	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
10,630 to 10,680 ⁸	n/a	3.5	34	20	24	28	32	35	36	36
10,700–11,700 ⁵	A	2.2	38	25	29	33	36	42	55	55
	B	3.5	33.5	17	24	28	32	35	40	45
12,200 to 13,250 ⁹	A	1.0	n/a	23	28	35	39	41	42	50
	B	2.0	n/a	20	25	28	30	32	37	47
17,700 to 18,820	A	2.2	38	25	29	33	36	42	55	55
	B	2.2	38	20	24	28	32	35	36	36
18,920 to 19,700 ¹⁰	A	2.2	38	25	29	33	36	42	55	55
	B	2.2	38	20	24	28	32	35	36	36
21,200 to 23,600 ^{7,11}	A	3.3	33.5	18	26	26	33	33	55	55
	B	3.3	33.5	17	24	24	29	29	40	50
24,250 to 25,250 ¹⁰	A	2.8	38	25	29	33	36	42	55	60
	B	2.8	38	20	24	28	32	35	36	45
31,000 to 31,300 ^{12,13}	n/a	4.0	38	n/a	n/a	n/a	n/a	n/a	n/a	n/a
38,600 to 40,000 ¹⁴	A	n/a	38	25	29	33	36	42	55	55
	B	n/a	38	20	24	28	32	35	36	36
71,000 to 76,000 (co-polar) ¹⁵	N/A	1.2	43	35	40	45	50	50	55	55
71,000 to 76,000 (cross-polar) ¹⁵	N/A	1.2	43	45	50	50	55	55	55	55
81,000 to 86,000 (co-polar) ¹⁵	N/A	1.2	43	35	40	45	50	50	55	55
81,000 to 86,000 (cross-polar) ¹⁵	N/A	1.2	43	45	50	50	55	55	55	55
92,000 to 95,000	N/A	0.6	50.0	36	40	45	50	55	55	55

¹ If a licensee chooses to show compliance using maximum beamwidth to 3 dB points, the beamwidth limit shall apply in both the azimuth and the elevation planes.

² Except for Multiple Address System frequencies listed in §§ 101.147(b)(1) through (b)(4), where omnidirectional antennas may be used.

³ Antennas used at outlying stations as part of a central protection alarm system need conform to only the following 2 standards:

- (i) The minimum on-beam forward gain must be at least 10 dBi, and
- (ii) The minimum front-to-back ratio must be at least 20 dB.

⁴ Omnidirectional antennas may be authorized in the band 2150–2160 MHz.

⁵ These antenna standards apply to all point-to-point stations authorized after June 1, 1997. Existing licensees and pending applicants on that date are grandfathered and need not comply with these standards.

⁶ These antenna standards apply to all point-to-point stations authorized on or before June 1, 1997.

⁷ Except for antennas between 140° and 180° authorized or pending on January 1, 1989, in the band 10,550 to 10,565 MHz for which minimum radiation suppression to angle (in degrees) from centerline of main beam is 36 decibels.

⁸ These antenna standards apply only to DEMS User Stations licensed, in operation, or applied for prior to July 15, 1993.

⁹ Except for Temporary-fixed operations in the band 13200–13250 MHz with output powers less than 250 mW and as provided in § 101.147(q), and except for antennas in the MVDDS service in the band 12.2–12.7 GHz.

¹⁰ DEMS User Station antennas in this band must meet performance Standard B and have a minimum antenna gain of 34 dBi. The maximum beamwidth requirement does not apply to DEMS User Stations. DEMS Nodal Stations need not comply with these standards. Stations authorized to operate in the 24,250–25,250 MHz band do not have to meet these standards, however, the Commission may require the use of higher performance antennas where interference problems can be resolved by the use of such antennas.

¹¹ Except as provided in § 101.147(s).

¹² The minimum front-to-back ratio shall be 38 dBi.

¹³ Mobile, except aeronautical mobile, stations need not comply with these standards.

¹⁴ Stations authorized to operate in the 38,600–40,000 MHz band may use antennas other than those meeting the Category A standard. However, the Commission may require the use of higher performance antennas where interference problems can be resolved by the use of such antennas.

¹⁵ Antenna gain less than 50 dBi (but greater than or equal to 43 dBi) is permitted only with a proportional reduction in maximum authorized EIRP in a ratio of 2 dB of power per 1 dB of gain, so that the maximum allowable EIRP (in dBW) for antennas of less than 50 dBi gain becomes $+55 - 2(50 - G)$, where G is the antenna gain in dBi. In addition, antennas in these bands must meet two additional standards for minimum radiation suppression: At angles between 1.2 and 5 degrees from the centerline of the main beam, co-polar discrimination must be $G - 28$, where G is the antenna gain in dBi; and at angles of less than 5 degrees from the centerline of main beam, cross-polar discrimination must be at least 25 dB.

(c) The Commission shall require the replacement of any antenna or periscope antenna system of a permanent fixed station operating at 932.5 MHz or higher that does not meet performance Standard A specified in paragraph (c) of this section, at the expense of the licensee operating such antenna, upon a showing that said antenna causes or is likely to cause interference to (or receive interference from) any other authorized or applied for station whereas a higher performance antenna is not likely to involve such interference. Antenna performance is expected to meet the standards of paragraph (c) of this section for parallel polarization. For cases of potential interference, an antenna will not be considered to meet Standard A unless the parallel polarization performance for the discrimination angle involved meets the requirements, even if the cross-polarization performance controls the interference.

(d) In cases where passive reflectors are employed in conjunction with transmitting antenna systems, the foregoing paragraphs of this section also will be applicable. However, in such instances, the center of the major lobe of radiation from the antenna normally must be directed at the passive reflector, and the center of the major lobe of radiation from the passive reflector directed toward the receiving station with which it communicates.

(e) Periscope antennas used at an electric power facility plant area will be excluded from the requirements of paragraph (c) of this section on a case-by-case basis where technical consider-

ations or safety preclude the use of other types of antenna systems.

(f) In the 10,700–11,700 MHz band, a fixed station may employ transmitting and receiving antennas meeting performance standard B in any area. If a Fixed Service or Fixed Satellite Service licensee or applicant makes a showing that it is likely to receive interference from such fixed station and that such interference would not exist if the fixed station used an antenna meeting performance standard A, the fixed station licensee must modify its use. Specifically, the fixed station licensee must either substitute an antenna meeting performance standard A or operate its system with an EIRP reduced so as not to radiate, in the direction of the other licensee, an EIRP in excess of that which would be radiated by a station using a Category A antenna and operating with the maximum EIRP allowed by the rules. A licensee or prior applicant using an antenna that does not meet performance Standard A may object to a prior coordination notice based on interference only if such interference would be predicted to exist if the licensee or prior applicant used an antenna meeting performance standard A.

(g) In the event harmful interference is caused to the operation of other stations, the Commission may, after notice and opportunity for hearing, order

changes to be made in the height, orientation, gain and radiation pattern of the antenna system.

[61 FR 26677, May 28, 1996, as amended at 62 FR 4924, Feb. 3, 1997; 62 FR 24582, May 6, 1997; 63 FR 6105, Feb. 6, 1998; 65 FR 38329, June 20, 2000; 65 FR 59358, Oct. 5, 2000; 67 FR 43038, June 26, 2002; 68 FR 4957, Jan. 31, 2003; 69 FR 3267, Jan. 23, 2004; 70 FR 29997, May 25, 2005; 72 FR 55677, Oct. 1, 2007; 73 FR 55775, Sept. 26, 2008]

§ 101.117 Antenna polarization.

Except as set forth herein, stations operating in the radio services included in this part are not limited as to the type of polarization of the radiated signal that may be employed. However, in the event interference in excess of permissible levels is caused to the operation of other stations as a result of employing other than linear polarization, the Commission may order a licensee to change its system polarization to mitigate the interference. No change in polarization may be made without prior authorization from the Commission. Unless otherwise allowed, only linear polarization (horizontal and vertical) shall be used. For LMDS systems, unless otherwise authorized, system operators are permitted to use any polarization within its service area, but only vertical and/or horizontal polarization for antennas located within 20 kilometers of the outermost edge of their service area.

[68 FR 4957, Jan. 31, 2003]

§ 101.119 Simultaneous use of common antenna structures.

The simultaneous use of common antenna structures by more than one radio station, or by one of more domestic public radio stations and one or more stations of any other class or service, may be authorized: provided, however, that each licensee or user of any such structure is responsible for maintaining the structure, and for painting and illuminating the structure when obstruction marking is required by the Commission. (See § 101.21(a).)

§ 101.125 Temporary fixed antenna height restrictions.

The overall antenna structure heights employed by mobile stations in

the Local Television Transmission Service and by stations authorized to operate at temporary fixed locations may not exceed the height criteria set forth in § 17.7 of this chapter, unless in each instance, authorization for use of a specific maximum antenna height (above ground and above mean sea level) for each location has been obtained from the Commission prior to erection of the antenna. Requests for such authorization must show the inclusive dates of the proposed operation. (Complete information as to rules concerning the construction, marking and lighting of antenna structures is contained in part 17 of this chapter.)

§ 101.129 Transmitter location.

(a) The applicant must determine, prior to filing an application for a radio station authorization, that the antenna site specified therein is adequate to render the service proposed. In cases of questionable antenna locations, it is desirable to conduct propagation tests to indicate the field intensity which may be expected in the principal areas or at the fixed points of communication to be served, particularly where severe shadow problems may be expected. In considering applications proposing the use of such locations, the Commission may require site survey tests to be made pursuant to a developmental authorization in the particular service concerned. In such cases, propagation tests should be conducted in accordance with recognized engineering methods and should be made with a transmitting antenna simulating, as near as possible, the proposed antenna installation. Full data obtained from such surveys and its analysis, including a description of the methods used and the name, address and qualifications of the engineer making the survey, must be supplied to the Commission.

(b) In the 12.2–12.7 GHz band, licensees must not locate MVDDS transmitting antennas within 10 km of any qualifying NGSO FSS receiver unless mutual agreement is obtained between the MVDDS and NGSO FSS licensees. Such agreements must be retained by the licensees and made available for inspection by interested parties upon request.